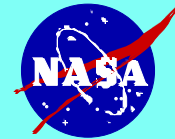


2000 V 6H-SiC PN Junction Diodes

Philip G. Neudeck, David J. Larkin, Carl S. Salupo,
J. Anthony Powell, and Lawrence G. Matus

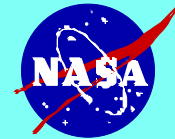
NASA Lewis Research Center
Cleveland, Ohio



Acknowledgments

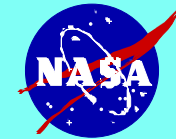
Robert Allen, Gerry Buchar, and Luann Keys
NASA Lewis Research Center

Research carried out under internal funding by
NASA Lewis Research Center, Cleveland, Ohio

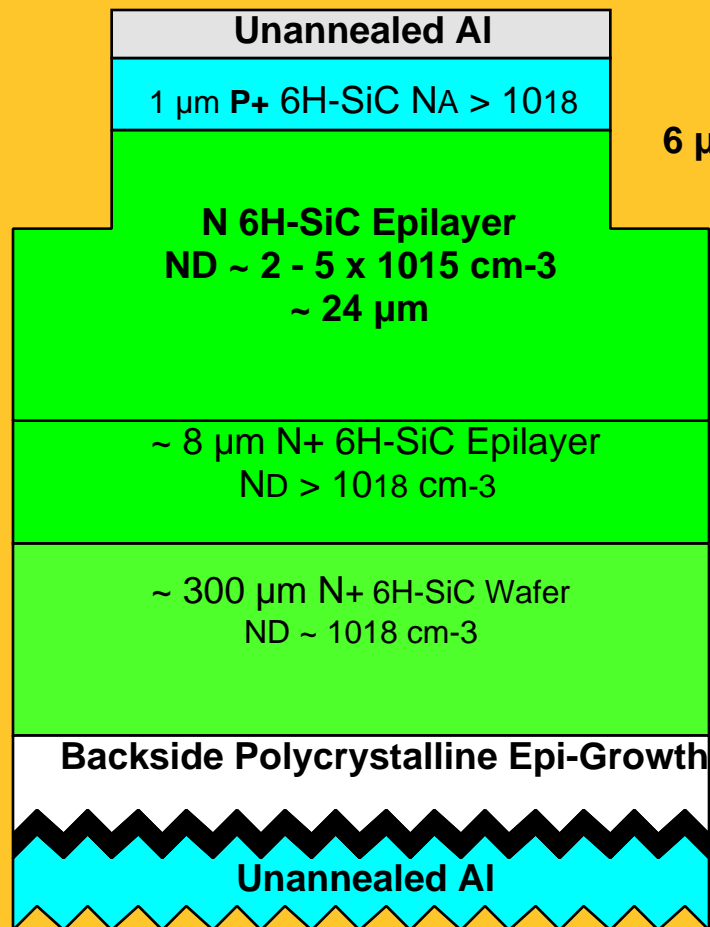


Key development areas for SiC power devices:

- Contact resistivities.
device on-state resistances.
- Thermal oxidation and surface passivation.
SiC MOSFET's, power device reliability.
- SiC wafer growth.
defects limit device areas, current ratings.
- SiC epilayer growth.
background dopings and uniformity.

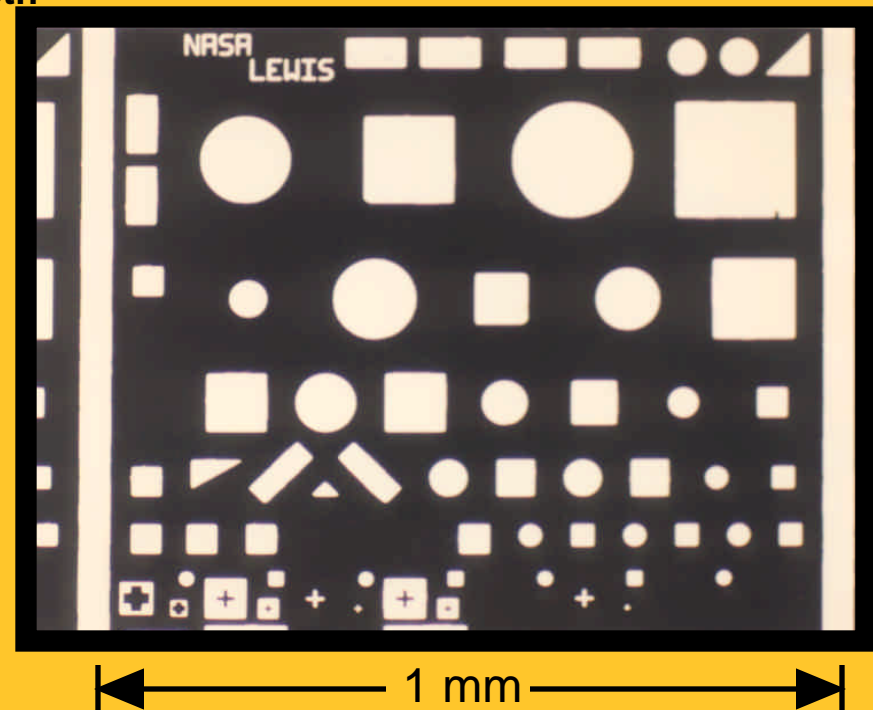


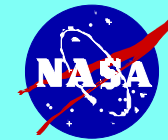
6H-SiC PN Junction Diodes



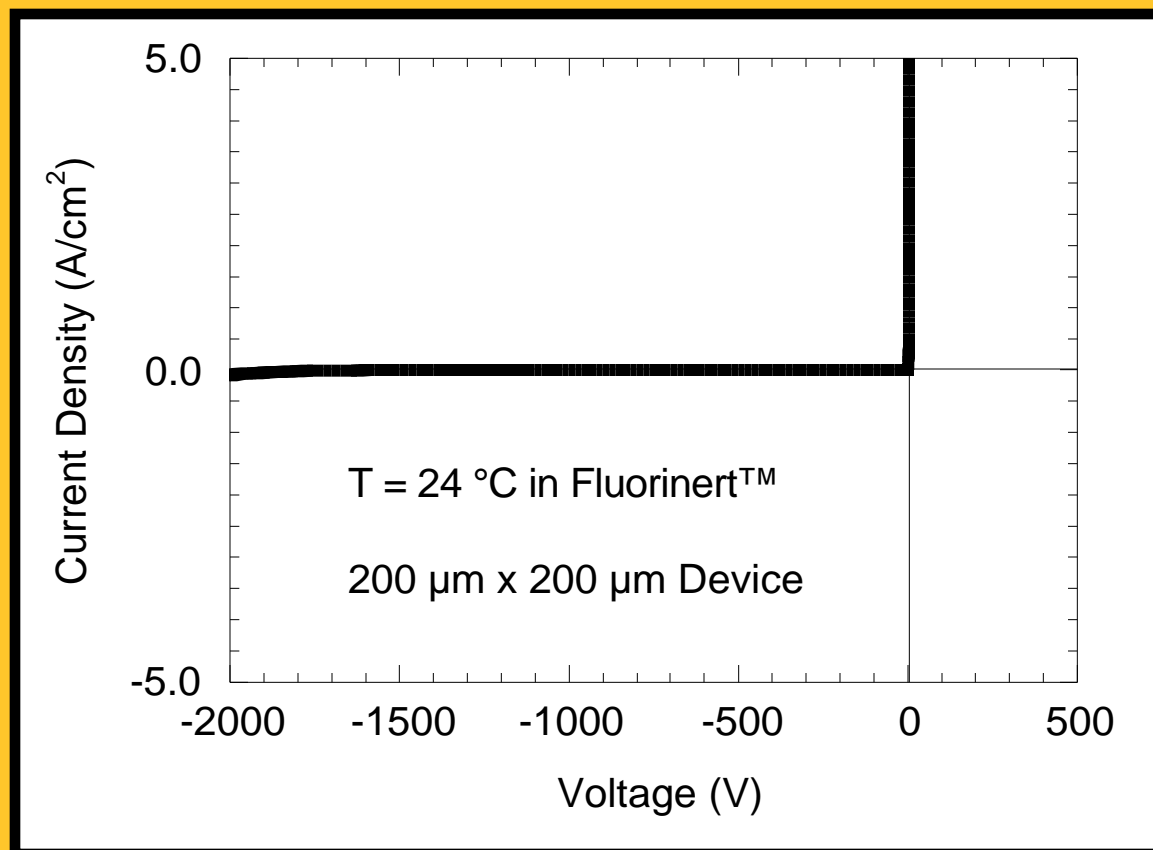
6 μm Etch Depth

Array of Small-Area Devices



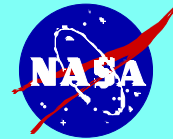


NASA Lewis 6H-SiC PN Diode

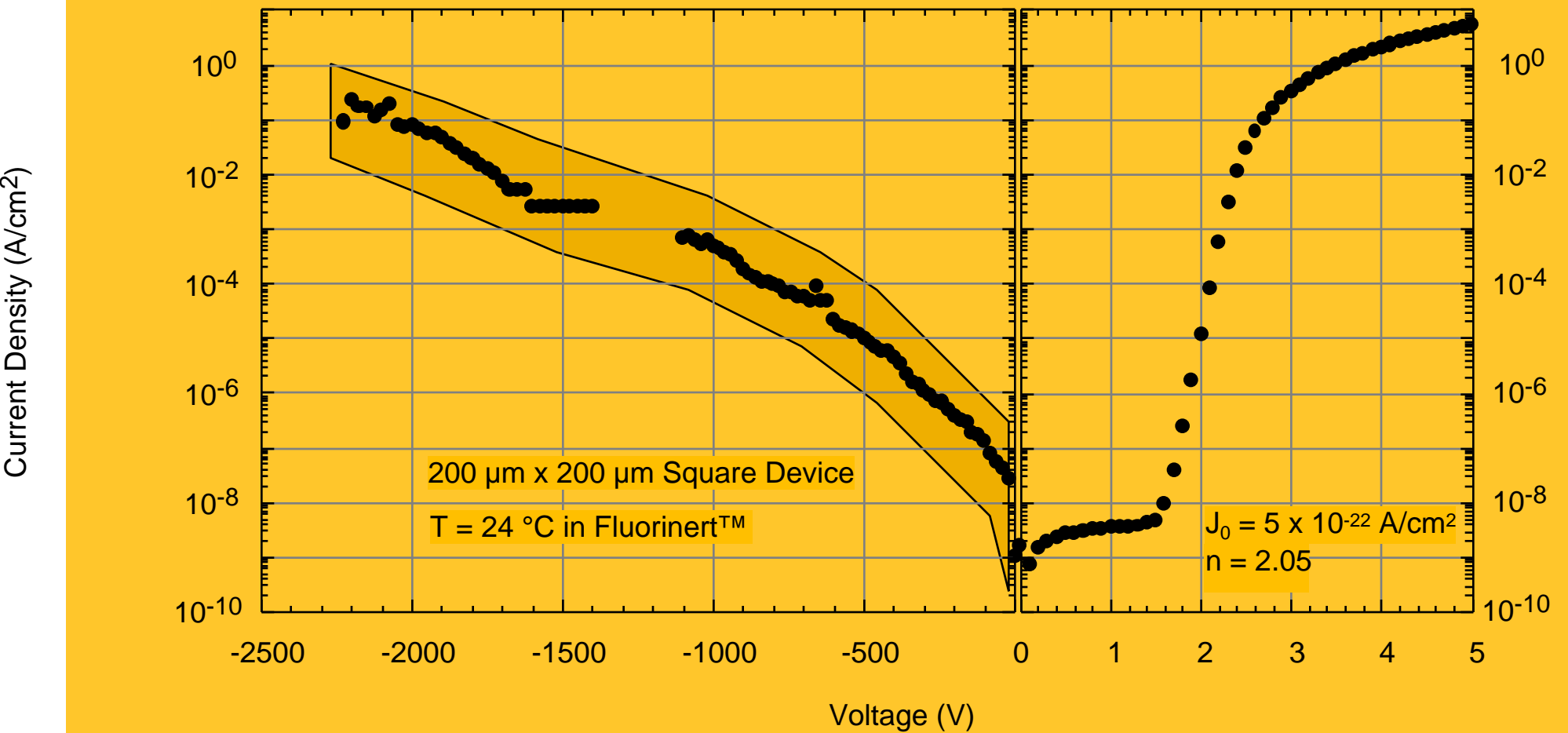


Previous best reported SiC diode blocking voltage: 1400 V

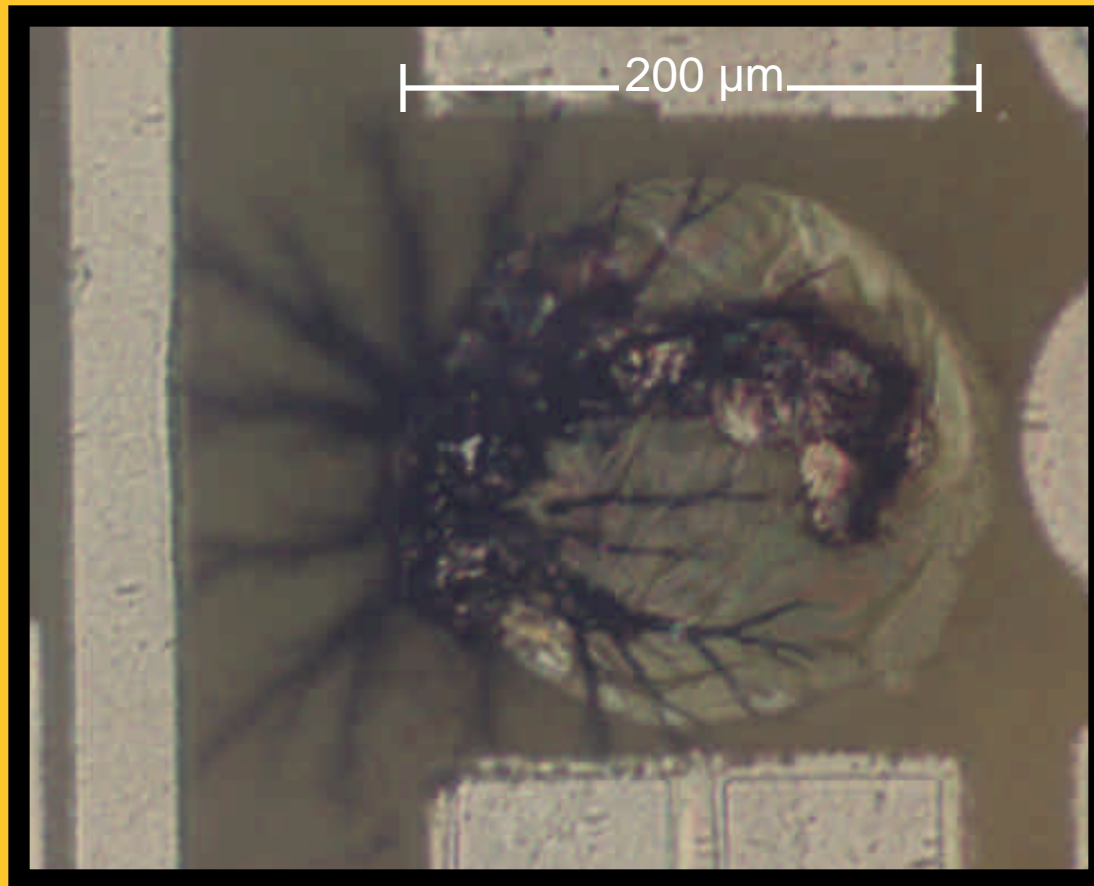
2000 V functional yield greater than 50% on small-area ($4 \times 10^{-4} \text{ cm}^2$) devices.



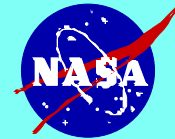
6H-SiC PN Diode Characteristics



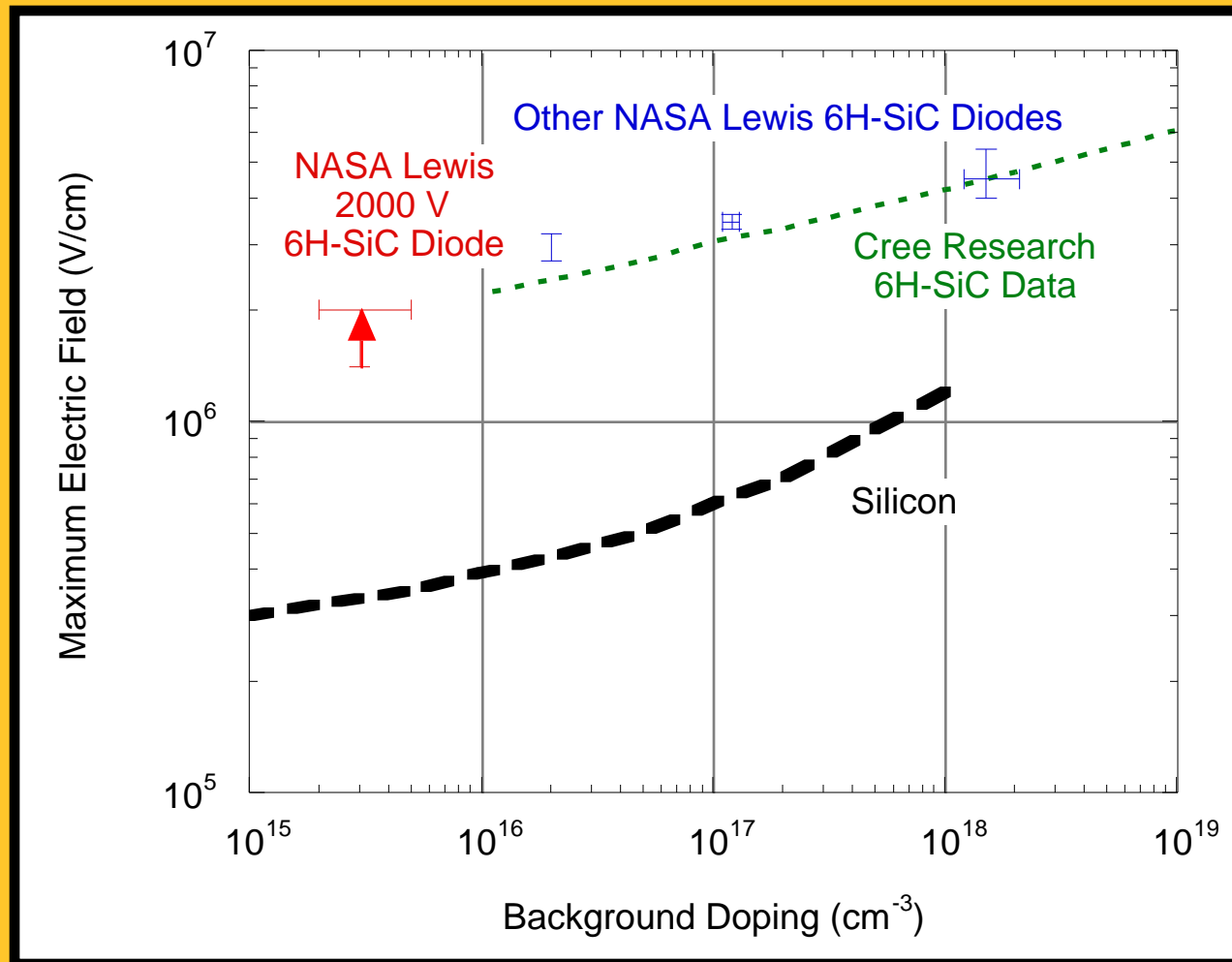
6H-SiC Diode after 2200 V Catastrophic Failure

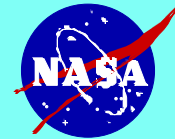


Failure appears to occur at diode periphery.



Measured PN Junction Breakdown Fields





Summary

- Site Competition Epitaxy has greatly improved dopant control in CVD SiC epilayers.
- Reduced epilayer doping has enabled demonstration of the first 2000 V SiC rectifiers ever reported.
- Surface passivation, crystal defects, and other key issues need to be addressed.
- Further improvements expected as crystal growth and processing technologies continue to mature.